

Claims

- [c1] 1. A method to control a clutch to connect an engine to a powertrain of a hybrid electric vehicle (HEV), comprising the steps of:
- determining an engine run command;
 - determining a filtered speed error of the engine and a starter/motor; and
 - generating a clutch position command.
- [c2] 2. The method of claim 1, wherein the HEV is a parallel HEV.
- [c3] 3. The method of claim 1, wherein the step of determining an engine run command comprises the steps of:
- determining whether the clutch is engaged;
 - determining whether the engine is at least spinning at a predetermined idle speed;
 - commanding a fuel request to the engine when the clutch is engaged and the engine is spinning at least at the predetermined idle speed.
- [c4] 4. The method of claim 3 wherein the predetermined idle speed is 750 RPM.
- [c5] 5. The method of claim 1, wherein the step of determining a filtered speed error comprises the steps of:
- determining a speed error;
 - determining a scaled speed error; and
 - inputting the scaled speed error to a digital lowpass filter.
- [c6] 6. The method of claim 5, wherein determining speed error comprises the steps of:
- sensing starter/alternator speed and engine speed; and
 - determining the difference of the starter/alternator speed and the engine speed.
- [c7] 7. The method of claim 5, wherein the step of determining scaled speed error comprises the steps of:
- determining a speed gain; and
 - multiplying the speed gain and the speed error.

- [c8] 8.The method of claim 5, wherein the step of determining filtered speed error comprises the steps of:
- multiplying the scaled speed error by a predetermined time constant (TC) and a current determination time step (K);
 - multiplying (1 TC) by the filtered speed error and (k 1); and
 - summing the step multiplying the scaled speed error by TC and a current determination time step (K) and the step of multiplying (1 TC) by the filtered speed error and (k 1).
- [c9] 9.The method of claim 8, wherein the predetermined time constant is 0.03.
- [c10] 10.The method of claim 1, wherein the step of generating a clutch position command comprises the steps of:
- sensing actual clutch position, whether an accelerator is applied, and whether a mechanical braking device is applied;
 - inputting actual clutch position to a vehicle system controller;
 - determining whether engine speed is greater than a predetermined idle speed;
 - commanding engagement of the clutch when the braking device is applied and the engine speed is greater than a predetermined idle speed;
 - and
 - commanding engagement of the clutch when both the braking device and the accelerator are applied and the engine speed is greater than a predetermined idle speed.
- [c11] 11.The method of claim 10, wherein the predetermined idle speed is 750 RPM.
- [c12] 12.A system to control a clutch to connect an engine to a powertrain of a hybrid electric vehicle comprising:
- a controller programmed to determine a filtered speed error of the engine and a starter/motor and to determine an engine run command;
 - monitoring devices operatively connected to said engine and said starter/motor connected to output data to said controller representing the speeds of said engine and said starter/motor; and
 - said controller programmed to generate a clutch position command

dependent on said data to a servo-actuator connected to the clutch.

- [c13] 13.The system of claim 12, wherein the controller further comprises programs for determining said engine run command, determining whether the clutch is engaged, and determining whether the engine is at least spinning at a predetermined idle speed.
- [c14] 14.A system according to claim 13 wherein said controller is programmed to command a fuel request to the engine when the clutch is engaged and the engine is spinning at least at the predetermined idle speed.
- [c15] 15.A hybrid electric vehicle (HEV) comprising a system to control a clutch to connect an engine to a powertrain of said HEV, said system comprising:
- a controller programmed to determine a filtered speed error of the engine and a starter/motor and to determine an engine run command;
 - monitoring devices operatively connected to said engine and said starter/motor connected to output data to said controller representing the speeds of said engine and said starter/motor; and
 - said controller programmed to generate a clutch position command dependent on said data to a servo-actuator connected to the clutch in response to said clutch position command.